

# The DSM-5 Approach to Evaluating Traumatic Brain Injury



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# Poll Question

TBI is...

- A. A life altering injury for survivors and their families, profoundly impacting the patient's neuropsychiatric status
- B. A very common injury that is essentially inconsequential to the individual's neuropsychiatric status following recovery
- C. Is this some sort of trick question?

# ANSWER

- Either may be true in a given case
- Addressing the neuropsychiatric needs of an individual with history of TBI requires identifying injuries and their sequelae
- It also requires evaluating the person with that injury and identifying other treatable neuropsychiatric conditions and psychosocial contributors – which often are present after TBI
- A useful diagnostic system will facilitate this process

# OEF/OIF and TBI

- TBI is a common physical injury among combatants in Afghanistan and Iraq
- Blast-related injury, including the biomechanical concomitants of blast exposure, is a common mechanism of injury (although not the only one)
- 2006 survey of more than 2,500 recently returned army infantry soldiers: 5% reported injuries with LOC during a year-long deployment, 10% reported injuries with altered mental status
- RAND report with even higher rates: 19% with probable TBI on survey of almost 2,000 previously deployed service personnel.
- Terrio et al. with similarly high rate (23%) of clinician-confirmed TBI in a U.S. Army brigade combat team with at least one deployment

Stein 2009



# The Challenge...

- Developing diagnostic criteria that facilitate identification of persons with TBI and TBI-related neuropsychiatric problems without limiting the focus of evaluation to TBI no small task
- Crafting those criteria so that they also comport with the DSM-5 structure adds to the complexity to this task
- Placing the outcomes of the APA's work on this task requires placing that work in the context of the earlier versions of the DSM

# DSM-III (1980)

- The index lacked the terms “traumatic brain injury” and “head injury” (the latter being the more commonly used term at the time)
- The index included an entry for “post-concussional syndrome” and advised readers to “see atypical or mixed organic brain syndrome”
  - however, the description of “atypical or mixed organic brain syndrome” did not describe post-concussional syndrome or mention head injury at all
- DSM-III-R with passing mention of “brain injury” as etiology for delirium and organic personality syndrome

# DSM-III-R (1987)

- The index of the DSM-III-R also did not include the terms “head injury,” “traumatic brain injury,” “postconcussional disorder,” or “postconcussive syndrome”
- However, the narrative describing etiologic factors for dementia made passing mention of “brain injury”
- “Head injury” also was identified as an etiologic factor for delirium and organic personality syndrome in the narratives describing these conditions

# **DSM-IV (1994) & DSM-IV-TR (2000)**

- Mentioned head trauma in the narratives describing delirium, amnestic disorder, dementia, Cognitive Disorder N.O.S., and personality change due to a general medical condition
- Offered specific criteria for Dementia due to Head Trauma (but model those criteria on Dementia due to Alzheimer's disease, which was a poor fit)
- The Cognitive Disorder N.O.S. text mentions “postconcussional disorder” and offered research criteria for the continued study of this condition



# DSM-IV (1994) & DSM-IV-TR (2000)

- **Postconcussional Disorder**

- this condition was presented only as a construct for further study (i.e., research criteria)
- the narrative accompanying these research criteria was brief
- the criteria for this condition varied substantially from the ICD-9-CM criteria for postconcussive syndrome and engendered controversy
- ultimately, these criteria proved to be of limited usefulness in either research or clinical practice and did not gain widespread acceptance

(Arciniegas and Silver 2001; Boake et al. 2004; Boake et al. 2005; McCauley et al. 2005, 2008; Ruff&Jurica 1999)



# DSM-5 (2013)

- TBI and its neuropsychiatric sequelae are considered in detail
- Criteria for diagnosing an injury event as TBI, and attributing neurocognitive problems to it, are offered
- In these respects, the DSM-5 approach to TBI represents is improved substantially over that in the prior editions of this manual

# Poll Question

My familiarity with DSM-5:

- A) I have adapted my diagnostic practices to the new manual and its criteria
- B) I am aware of some differences in the new manual but not yet routinely applying them
- C) I have not yet begun to explore the new manual
- D) I'm reading *Game of Thrones* instead

# **TBI in DSM-5: A Neurocognitive Disorder**

- TBI and its neuropsychiatric sequelae are addressed principally within framework of the Neurocognitive Disorders (NCD)
  - this NCDs are the renamed and reframed criteria for all conditions *except delirium* that were included in the “Delirium, Dementia, Amnestic, and Other Cognitive Disorders” chapter of the DSM-IV-TR
- The NCDs are conditions in which impaired cognition is present and is not the result of a congenital or early developmental cause

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# Mild Neurocognitive Disorder

- A. Evidence of modest\* cognitive decline from a previous level of performance in one or more cognitive domains (complex attention, executive function, learning and memory, language, perceptual-motor, or social cognition) based on:
1. Concern of the individual, a knowledgeable informant, or the clinician that there has been a significant decline in cognitive function; and
  2. A substantial impairment in cognitive performance, preferably documented by standardized neuropsychological testing or, in its absence, another quantified clinical assessment.
- B. The cognitive deficits **do not** interfere with independence in everyday activities (but greater effort, compensatory strategies, or accommodation may be required).
- C. The cognitive deficits do not occur exclusively in the context of a delirium.
- D. The cognitive deficits are not better explained by another mental disorder (e.g., major depressive disorder, schizophrenia)

\* *“modest” cognitive decline is defined in the DSM-5 as performance on standardized cognitive tests equivalent to  $Z = -1$  to  $-2$  (i.e., between the 3<sup>rd</sup>-16<sup>th</sup>%-ile)*



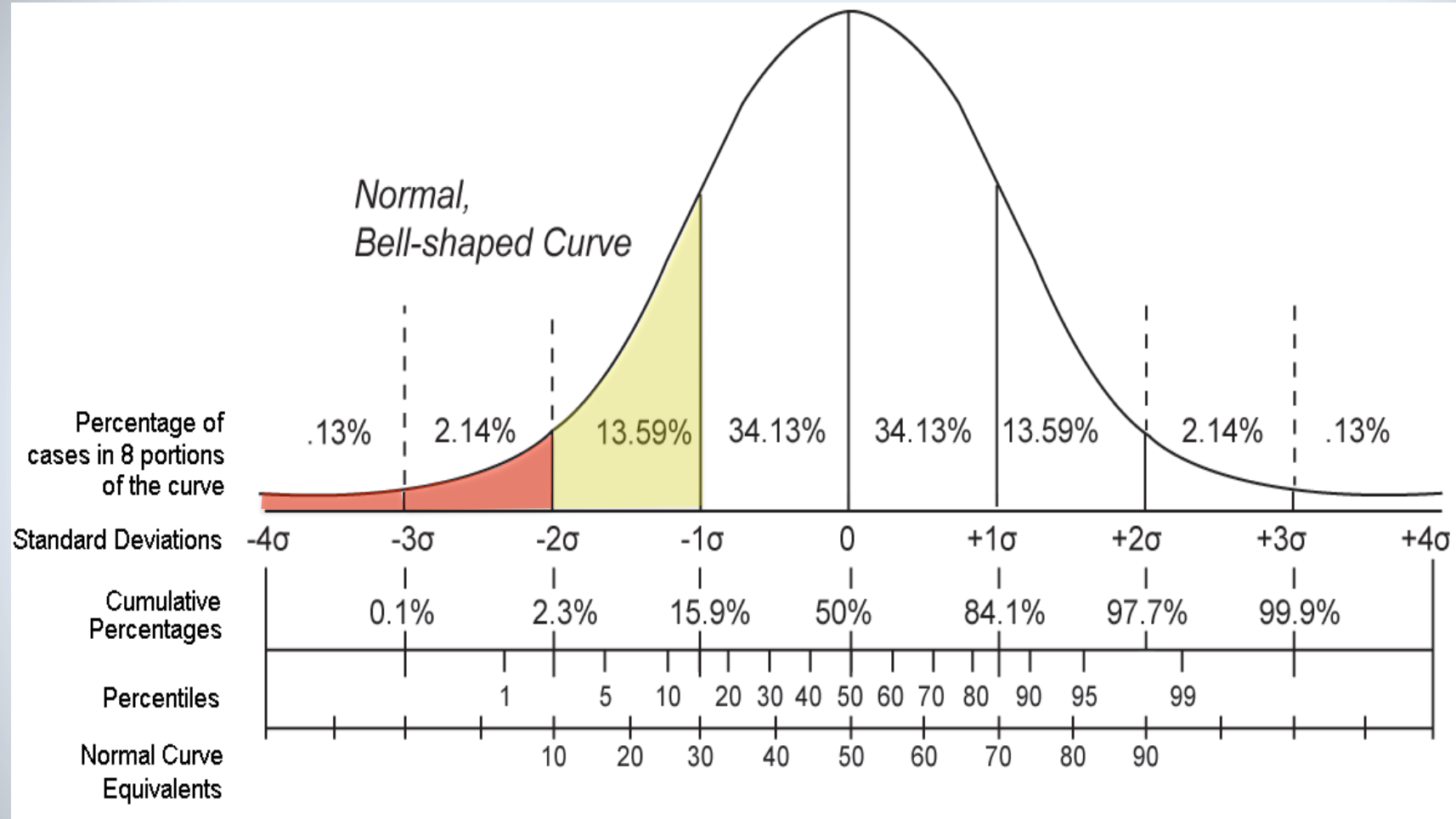
# Major Neurocognitive Disorder

- A. Evidence of significant\* cognitive decline from a previous level of performance in one or more cognitive domains (complex attention, executive function, learning and memory, language, perceptual-motor, or social cognition) based on:
1. Concern of the individual, a knowledgeable informant, or the clinician that there has been a significant decline in cognitive function; and
  2. A substantial impairment in cognitive performance, preferably documented by standardized neuropsychological testing or, in its absence, another quantified clinical assessment.
- B. The cognitive deficits interfere with independence in everyday activities (i.e., at a minimum, requiring assistance with complex instrumental activities of daily living).
- C. The cognitive deficits do not occur exclusively in the context of a delirium.
- D. The cognitive deficits are not better explained by another mental disorder (e.g., major depressive disorder, schizophrenia)

\* *“significant” cognitive decline is defined in the DSM-5 as performance on standardized cognitive tests equivalent to  $Z \leq -2$  ( $\leq 3^{\text{rd}}$ -ile)*



# Cognitive Examination Interpretation



For measures like the MMSE or MoCA, where higher scores are better:

$$\text{Z-score} = \frac{([\text{patient score}] - [\text{cohort mean}])}{[\text{cohort standard deviation}]}$$



# Mini-Mental State Examination

## APPENDIX

Patient. ....  
Examiner .....  
Date .....

### "MINI-MENTAL STATE"

Maximum  
Score Score

#### ORIENTATION

- 5 ( ) What is the (year) (season) (date) (day) (month)?  
5 ( ) Where are we: (state) (county) (town) (hospital) (floor).

#### REGISTRATION

- 3 ( ) Name 3 objects: 1 second to say each. Then ask the patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he learns all 3. Count trials and record.

Trials

#### ATTENTION AND CALCULATION

- 5 ( ) Serial 7's. 1 point for each correct. Stop after 5 answers. Alternatively spell "world" backwards.

#### RECALL

- 3 ( ) Ask for the 3 objects repeated above. Give 1 point for each correct.

#### LANGUAGE

- 9 ( ) Name a pencil, and watch (2 points)  
Repeat the following "No ifs, ands or buts." (1 point)  
Follow a 3-stage command:  
"Take a paper in your right hand, fold it in half, and put it on the floor"  
(3 points)

Read and obey the following:

CLOSE YOUR EYES (1 point)

Write a sentence (1 point)

Copy design (1 point)

\_\_\_\_\_ Total score

ASSESS level of consciousness along a continuum \_\_\_\_\_

Alert Drowsy Stupor Coma

## INSTRUCTIONS FOR ADMINISTRATION OF MINI-MENTAL STATE EXAMINATION

### ORIENTATION

- (1) Ask for the date. Then ask specifically for parts omitted, e.g., "Can you also tell me what season it is?" One point for each correct.  
(2) Ask in turn "Can you tell me the name of this hospital?" (town, county, etc.). One point for each correct.

### REGISTRATION

Ask the patient if you may test his memory. Then say the names of 3 unrelated objects, clearly and slowly, about one second for each. After you have said all 3, ask him to repeat them. This first repetition determines his score (0-3) but keep saying them until he can repeat all 3, up to 6 trials. If he does not eventually learn all 3, recall cannot be meaningfully tested.

### ATTENTION AND CALCULATION

Ask the patient to begin with 100 and count backwards by 7. Stop after 5 subtractions (93, 86, 79, 72, 65). Score the total number of correct answers.

If the patient cannot or will not perform this task, ask him to spell the word "world" backwards. The score is the number of letters in correct order. E.g. dlrow = 5, dlrow = 3.

### RECALL

Ask the patient if he can recall the 3 words you previously asked him to remember. Score 0-3.

### LANGUAGE

*Naming:* Show the patient a wrist watch and ask him what it is. Repeat for pencil. Score 0-2.

*Repetition:* Ask the patient to repeat the sentence after you. Allow only one trial. Score 0 or 1.

*3-Stage command:* Give the patient a piece of plain blank paper and repeat the command. Score 1 point for each part correctly executed.

*Reading:* On a blank piece of paper print the sentence "Close your eyes", in letters large enough for the patient to see clearly. Ask him to read it and do what it says. Score 1 point only if he actually closes his eyes.

*Writing:* Give the patient a blank piece of paper and ask him to write a sentence for you. Do not dictate a sentence, it is to be written spontaneously. It must contain a subject and verb and be sensible. Correct grammar and punctuation are not necessary.

*Copying:* On a clean piece of paper, draw intersecting pentagons, each side about 1 in., and ask him to copy it exactly as it is. All 10 angles must be present and 2 must intersect to score 1 point. Tremor and rotation are ignored.

Estimate the patient's level of sensorium along a continuum, from alert on the left to coma on the right.

Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975;12(3):189-98.



# Population-Based Norms for the Mini-Mental State Examination by Age and Educational Level

Rosa M. Crum, MD, MHS; James C. Anthony, PhD; Susan S. Bassett, PhD; Marshal F. Folstein, MD

**Objective.**—To report the distribution of Mini-Mental State Examination (MMSE) scores by age and educational level.

**Design.**—National Institute of Mental Health Epidemiologic Catchment Area Program surveys conducted between 1980 and 1984.

**Setting.**—Community populations in New Haven, Conn; Baltimore, Md; St Louis, Mo; Durham, NC; and Los Angeles, Calif.

**Participants.**—A total of 18 056 adult participants selected by probability sampling within census tracts and households.

**Main Outcome Measures.**—Summary scores for the MMSE are given in the form of mean, median, and percentile distributions specific for age and educational level.

**Results.**—The MMSE scores were related to both age and educational level. There was an inverse relationship between MMSE scores and age, ranging from a median of 29 for those 18 to 24 years of age, to 25 for individuals 80 years of age and older. The median MMSE score was 29 for individuals with at least 9 years of schooling, 26 for those with 5 to 8 years of schooling, and 22 for those with 0 to 4 years of schooling.

**Conclusions.**—Cognitive performance as measured by the MMSE varies within the population by age and education. The cause of this variation has yet to be determined. Mini-Mental State Examination scores should be used to identify current cognitive difficulties and not to make formal diagnoses. The results presented should prove to be useful to clinicians who wish to compare an individual patient's MMSE scores with a population reference group and to researchers making plans for new studies in which cognitive status is a variable of interest.

While the MMSE has limited specificity with respect to individual clinical syndromes, it is a brief, standardized method to grade patients' cognitive mental status. It assesses orientation, attention, immediate and short-term recall, language, and the ability to follow simple verbal and written commands (Fig 1). It provides a total score that places the individual on a scale of cognitive function.

The MMSE has been used within different cultural and ethnic subgroups and has been translated into several different languages.<sup>10,11,17,18</sup> A modified version has been used successfully with the hearing impaired.<sup>19</sup> Furthermore, the MMSE has been used as a method of predicting intellectual level,<sup>20</sup> as well as predicting attrition of elderly subjects from a longitudinal study.<sup>21</sup> High correlation with other, more comprehensive standardized instruments for the assessment of cognitive function, such as the Wechsler Adult Intelligence Scale,<sup>4</sup> and other screening tests, such as the Modified Blessed Test, has been reported.<sup>22,23</sup> Scores correlate with several physio-

# MMSE Normative Data – Crum et al. 1993

Educational Level	Age, y														Total
	18-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	≥85	
<b>0 to 4 y</b>															
n	17	23	41	33	36	28	34	49	88	126	139	112	105	61	<b>892</b>
Mean	22	25	25	23	23	23	23	22	23	22	22	21	20	19	22
SD	2.9	2.0	2.4	2.5	2.6	3.7	2.6	2.7	1.9	1.9	1.7	2.0	2.2	2.9	2.3
Lower quartile	21	23	23	20	20	20	20	20	19	19	19	18	16	15	19
Median	23	25	26	24	23	23	22	22	22	22	21	21	19	20	22
Upper quartile	25	27	28	27	27	26	25	26	26	25	24	24	23	23	25
<b>5 to 8 y</b>															
n	94	83	74	101	100	121	154	208	310	633	533	437	241	134	<b>3223</b>
Mean	27	27	26	26	27	26	27	26	26	26	26	25	25	23	26
SD	2.7	2.5	1.8	2.8	1.8	2.5	2.4	2.9	2.3	1.7	1.8	2.1	1.9	3.3	2.2
Lower quartile	24	25	24	23	25	24	25	25	24	24	24	22	22	21	23
Median	28	27	26	27	27	27	27	27	27	27	26	26	25	24	26
Upper quartile	29	29	28	29	29	29	29	29	29	29	28	28	27	27	28
<b>9 to 12 y or high school diploma</b>															
n	1326	958	822	668	489	423	462	525	626	814	550	315	163	99	<b>8240</b>
Mean	29	29	29	28	28	28	28	28	28	28	27	27	25	26	28
SD	2.2	1.3	1.3	1.8	1.9	2.4	2.2	2.2	1.7	1.4	1.6	1.5	2.3	2.0	1.9
Lower quartile	28	28	28	28	28	27	27	27	27	27	26	25	23	23	27
Median	29	29	29	29	29	29	29	29	28	28	28	27	26	26	29
Upper quartile	30	30	30	30	30	30	30	30	30	29	29	29	28	28	30
<b>College experience or higher degree</b>															
n	783	1012	989	641	354	259	220	231	270	358	255	181	96	52	<b>5701</b>
Mean	29	29	29	29	29	29	29	29	29	29	28	28	27	27	29
SD	1.3	0.9	1.0	1.0	1.7	1.6	1.9	1.5	1.3	1.0	1.6	1.6	0.9	1.3	1.3
Lower quartile	29	29	29	29	29	29	28	28	28	28	27	27	26	25	29
Median	30	30	30	30	30	30	30	29	29	29	29	28	28	28	29
Upper quartile	30	30	30	30	30	30	30	30	30	30	29	29	29	29	30
<b>Total, n</b>	<b>2220</b>	<b>2076</b>	<b>1926</b>	<b>1443</b>	<b>979</b>	<b>831</b>	<b>870</b>	<b>1013</b>	<b>1294</b>	<b>1931</b>	<b>1477</b>	<b>1045</b>	<b>605</b>	<b>346</b>	<b>18 056</b>
Mean	29	29	29	29	28	28	28	28	28	27	27	26	25	24	28
SD	2.0	1.3	1.3	1.8	2.0	2.5	2.4	2.5	2.0	1.6	1.8	2.1	2.2	2.9	2.0
Lower quartile	28	28	28	28	27	27	27	26	26	26	24	23	21	21	27
Median	29	29	29	29	29	29	29	29	28	28	27	26	25	25	29
Upper quartile	30	30	30	30	30	30	30	30	29	29	29	28	28	28	30

\*Data from the Epidemiologic Catchment Area household surveys in New Haven, Conn; Baltimore, Md; St Louis, Mo; Durham, NC; and Los Angeles, Calif, between 1980 and 1984. The data are weighted based on the 1980 US population census by age, sex, and race.

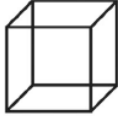


# Montreal Cognitive Examination

**MONTREAL COGNITIVE ASSESSMENT (MOCA)**  
Version 7.1 Original Version

NAME: \_\_\_\_\_ Education: \_\_\_\_\_ Date of birth: \_\_\_\_\_  
Sex: \_\_\_\_\_ DATE: \_\_\_\_\_


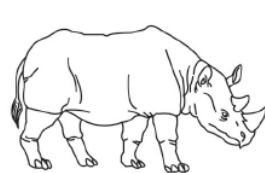
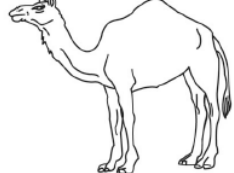
**VISUOSPATIAL / EXECUTIVE**

Copy cube  [ ]

Draw CLOCK (Ten past eleven) (3 points) [ ] [ ] [ ]

POINTS: \_\_\_\_/5

**NAMING**

 [ ]  [ ]  [ ]

POINTS: \_\_\_\_/3

**MEMORY**

Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.

	FACE	VELVET	CHURCH	DAISY	RED
1st trial					
2nd trial					

No points

**ATTENTION**

Read list of digits (1 digit/ sec.). Subject has to repeat them in the forward order [ ] 2 1 8 5 4  
Subject has to repeat them in the backward order [ ] 7 4 2

POINTS: \_\_\_\_/2

Read list of letters. The subject must tap with his hand at each letter A. No points if  $\geq 2$  errors  
[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

POINTS: \_\_\_\_/1

Serial 7 subtraction starting at 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 or 5 correct subtractions: **3 pts**, 2 or 3 correct: **2 pts**, 1 correct: **1 pt**, 0 correct: **0 pt**

POINTS: \_\_\_\_/3

**LANGUAGE**

Repeat: I only know that John is the one to help today. [ ]  
The cat always hid under the couch when dogs were in the room. [ ]

POINTS: \_\_\_\_/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] \_\_\_\_\_ (N  $\geq 11$  words)

POINTS: \_\_\_\_/1

**ABSTRACTION**

Similarity between e.g. banana - orange = fruit [ ] train - bicycle [ ] watch - ruler

POINTS: \_\_\_\_/2

**DELAYED RECALL**

Has to recall words WITH NO CUE	FACE	VELVET	CHURCH	DAISY	RED	Points for UNCUED recall only
Category cue	[ ]	[ ]	[ ]	[ ]	[ ]	
Multiple choice cue						

POINTS: \_\_\_\_/5

**Optional**

**ORIENTATION**

[ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City

POINTS: \_\_\_\_/6

© Z.Nasreddine MD [www.mocatest.org](http://www.mocatest.org) Normal  $\geq 26 / 30$  TOTAL \_\_\_\_/30  
Administered by: \_\_\_\_\_ Add 1 point if  $\leq 12$  yr edu

## NORMATIVE DATA

THESE ARE NOT NORMATIVE DATA. THEY ARE RESULTS FROM A SINGLE, SMALL, DEMOGRAPHICALLY NARROW CONTROL GROUP

## MOCA SCORES

	Normal Control (NC)	Mild Cognitive Impairment (MCI)	Alzheimer's Disease (AD)
Number of subjects	90	94	93
MoCA average score	27.4	22.1	16.2
MoCA standard deviation	2.2	3.1	4.8
MoCA score range	25.2 – 29.6	19.0 – 25.2	21.0 – 11.4
Suggested cut-off score	$\geq 26$	$< 26$	$< 26\psi$

$\psi$  Although the average MoCA score for the AD group is much lower than the MCI group, there is overlap between them. The suggested MoCA cut-off score is thus the same for both. The distinction between AD and MCI is mostly dependent on the presence of associated functional impairment and not on a specific score on the MoCA test.

## Sensitivity and Specificity (%) MoCA and MMSE

Cut-off	$\geq 26$	$< 26$	$< 26$
Group (n)	Normal controls (90)	Mild Cognitive Impairment (94)	Alzheimer Disease (93)
MoCA	87	90	100
MMSE	100	18	78



# Normative data for the Montreal Cognitive Assessment (MoCA) in a population-based sample

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## ABSTRACT

**Objective:** To provide normative and descriptive data for the Montreal Cognitive Assessment (MoCA) in a large, ethnically diverse sample.

**Methods:** The MoCA was administered to 2,653 ethnically diverse subjects as part of a population-based study of cardiovascular disease (mean age 50.30 years, range 18–85; Caucasian 34%, African American 52%, Hispanic 11%, other 2%). Normative data were generated by age and education. Pearson correlations and analysis of variance were used to examine relationship to demographic variables. Frequency of missed items was also reviewed.

**Results:** Total scores were lower than previously published normative data (mean 23.4, SD 4.0), with 66% falling below the suggested cutoff (<26) for impairment. Most frequently missed items included the cube drawing (59%), delayed free recall (56%; <4/5 words), sentence repetition (55%), placement of clock hands (43%), abstraction items (40%), and verbal fluency (38%; <11 words in 1 minute). Normative data stratified by age and education were derived.

**Conclusion:** These findings highlight the need for population-based norms for the MoCA and use of caution when applying established cut scores, particularly given the high failure rate on certain items. Demographic factors must be considered when interpreting this measure. *Neurology*® 2011;77:1272–1275

## GLOSSARY

AD = Alzheimer disease; DHS = Dallas Heart Study; MCI = mild cognitive impairment; MoCA = Montreal Cognitive Assessment.

# MoCA Norms by Age and Education

**Table 2** Montreal Cognitive Assessment score by age and education level

Age group, y	Years of education						Total by age	
	<12		12		>12			
	No.	Mean (SD) median	No.	Mean (SD) median	No.	Mean (SD) median	No.	Mean (SD) median
<35	20	22.80 (3.38) 23	65	24.46 (3.49) 25	122	25.93 (2.48) 26	207	25.16 (3.08) 26
30-40	37	22.84 (3.18) 23	106	23.99 (2.93) 24	264	25.81 (2.64) 26	408	25.07 (2.95) 25
35-45	55	22.11 (3.33) 23	177	23.02 (3.67) 24	355	25.38 (3.05) 26	588	24.37 (3.51) 25
40-50	77	21.36 (3.73) 22	227	22.26 (3.94) 23	418	25.09 (3.16) 26	723	23.80 (3.80) 24
45-55	77	20.75 (3.80) 21	216	21.87 (3.95) 22	461	24.70 (3.24) 25	755	23.48 (3.84) 24
50-60	62	19.94 (4.34) 20	172	22.25 (3.46) 22	424	24.34 (3.38) 25	659	23.37 (3.78) 24
55-65	60	19.60 (4.14) 20	143	21.58 (3.93) 22	369	24.43 (3.31) 25	573	23.20 (3.96) 23
60-70	57	19.30 (3.79) 19	113	20.89 (4.50) 21	246	24.32 (3.04) 25	418	22.69 (4.12) 23
65-75	38	18.37 (3.87) 19	67	20.57 (4.79) 21	122	24.00 (3.35) 24	228	22.05 (4.48) 23
70-80	14	16.07 (3.17) 17	23	20.35 (4.91) 20	42	23.60 (3.47) 24	79	21.32 (4.78) 22
Total by education	230	20.55 (4.04) 21	608	22.34 (3.97) 23	1,306	24.81 (3.20) 25	2,148	23.65 (3.84) 24

From Rosetti HC, Lacritz LK, Cullm CM, Weiner MF: Normative data for the Montreal Cognitive Assessment (MoCA) in a population-based sample. Neurology 2011;77:1272-1275.





# Major or Mild Neurocognitive Disorder Due to Traumatic Brain Injury

## Diagnostic Criteria

- A. The criteria are met for major or mild neurocognitive disorder.
- B. There is evidence of a traumatic brain injury—that is, an impact to the head or other mechanisms of rapid movement or displacement of the brain within the skull, with one or more of the following:
  - 1. Loss of consciousness.
  - 2. Posttraumatic amnesia.
  - 3. Disorientation and confusion.
  - 4. Neurological signs (e.g., neuroimaging demonstrating injury; a new onset of seizures; a marked worsening of a preexisting seizure disorder; visual field cuts; anisotropia; hemiparesis).
- C. The neurocognitive disorder presents immediately after the occurrence of the traumatic brain injury or immediately after recovery of consciousness and persists past the acute post-injury period.

**Coding note:** For major neurocognitive disorder due to traumatic brain injury, with behavioral disturbance: For ICD-9-CM, first code **907.0** late effect of intracranial injury without skull fracture, followed by **294.11** major neurocognitive disorder due to traumatic brain injury, with behavioral disturbance. For ICD-10-CM, first code **S06.2X9S** diffuse traumatic brain injury with loss of consciousness of unspecified duration, sequela; followed by **F02.81** major neurocognitive disorder due to traumatic brain injury, with behavioral disturbance.

For major neurocognitive disorder due to traumatic brain injury, without behavioral disturbance: For ICD-9-CM, first code **907.0** late effect of intracranial injury without skull fracture, followed by **294.10** major neurocognitive disorder due to traumatic brain injury, without behavioral disturbance. For ICD-10-CM, first code **S06.2X9S** diffuse traumatic brain injury with loss of consciousness of unspecified duration, sequela; followed by **F02.80** major neurocognitive disorder due to traumatic brain injury, without behavioral disturbance.

For mild neurocognitive disorder due to traumatic brain injury, code **331.83 (G31.84)**. (**Note:** Do *not* use the additional code for traumatic brain injury. Behavioral disturbance cannot be coded but should still be indicated in writing.)

American Psychiatric Association DSM-5 Task Force. Diagnostic and Statistical Manual of Mental Disorders: DSM-5. Washington, D.C.: American Psychiatric Association, 2013, pg. 624.



# Neurocognitive Disorder Due to TBI

- B. There is evidence of a traumatic brain injury—that is, an impact to the head or other mechanisms of rapid movement or displacement of the brain within the skull, with one or more of the following:
1. Loss of consciousness.
  2. Posttraumatic amnesia.
  3. Disorientation and confusion.
  4. Neurological signs (e.g., neuroimaging demonstrating injury, a new onset of seizures, or a marked worsening of a preexisting seizure disorder, visual field cuts, anosmia, hemiparesis).
- C. The neurocognitive disorder presents immediately after the occurrence of a traumatic brain injury or immediately after recovery of consciousness, and persists past the acute post-injury period.

- These criteria for TBI are modeled on those developed by the American Congress of Rehabilitation Medicine (ACRM) in 1993 and published as:
  - Kay T, Harrington DE, Adams RE, Anderson TW, Berrol S, Cicerone K, Dahlberg C, Gerber D, Goka RS, Harley JP, Hilt J, Horn LJ, Lehmkuhl D, Malec J. (1993). Definition of mild traumatic brain injury: Report from the Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine. *Journal of Head Trauma Rehabilitation*, 8(3), 86-87.
- They have since been adopted and/or adapted by the CDC, DoD, VA, NIDRR, and NINDS





# Poll Question

TBI severity classification is based on:

- A) clinical phenomena at the time of injury.
- B) long-term symptomatic and functional outcome.

## Answer

Clinical phenomena at the time of injury.

# American Congress of Rehabilitation Medicine Definition of Mild TBI:

*Developed by the Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine*

## DEFINITION

A patient with mild traumatic brain injury is a person who has had a traumatically induced physiological disruption of brain function, as manifested by **at least** one of the following:

1. any period of loss of consciousness;
2. any loss of memory for events immediately before or after the accident;
3. any alteration in mental state at the time of the accident (eg, feeling dazed, disoriented, or confused); and
4. focal neurological deficit(s) that may or may not be transient;

but where the severity of the injury does not exceed the following:

- loss of consciousness of approximately 30 minutes or less;
- after 30 minutes, an initial Glasgow Coma Scale (GCS) of 13–15; and
- posttraumatic amnesia (PTA) not greater than 24 hours.

Kay, T., Harrington, D. E., Adams, R. E., Anderson, T. W., Berrol, S., Cicerone, K., Dahlberg, C., Gerber, D., Goka, R. S., Harley, J. P., Hilt, J., Horn, L. J., Lehmkuhl, D., & Malec, J. (1993). Definition of mild traumatic brain injury: Report from the Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine. *Journal of Head Trauma Rehabilitation*, 8(3), 86-87.



# TBI Severity Classification

**TABLE 2** Severity ratings for traumatic brain injury

Injury characteristic	Mild TBI	Moderate TBI	Severe TBI
Loss of consciousness	<30 min	30 minutes–24 hours	>24 hours
Posttraumatic amnesia	<24 hours	24 hours–7 days	>7 days
Disorientation and confusion at initial assessment (Glasgow Coma Scale Score)	13–15 (not below 13 at 30 minutes)	9–12	3–8

Neurocognitive Disorder due to Traumatic Brain Injury. American Psychiatric Association DSM-5 Task Force. Diagnostic and Statistical Manual of Mental Disorders: DSM-5. Washington, D.C.: American Psychiatric Association, 2013, pg. 626

# TBI Severity Classification

**Table A-1. Classification of TBI Severity**

Criteria	Mild	Moderate	Severe
Structural imaging	Normal	Normal or abnormal	Normal or abnormal
Loss of Consciousness (LOC)	0–30 min	> 30 min and < 24 hrs	> 24 hrs
Alteration of consciousness/mental state (AOC) *	a moment up to 24 hrs	> 24 hours. Severity based on other criteria	
Post-traumatic amnesia (PTA)	0–1 day	> 1 and < 7 days	> 7 days
Glasgow Coma Scale (best available score in first 24 hours)	13-15	9-12	< 9

\* Alteration of mental status must be immediately related to the trauma to the head. Typical symptoms would be: looking and feeling dazed and uncertain of what is happening, confusion, difficulty thinking clearly or responding appropriately to mental status questions, and being unable to describe events immediately before or after the trauma event.

From Department of Veterans Affairs and Department of Defense. (2009). Clinical Practice Guideline: Management of Concussion/mild Traumatic Brain Injury. 2009 Retrieved March 3, 2014, from [http://www.healthquality.va.gov/mtbi/concussion\\_mtbi\\_full\\_1\\_0.pdf](http://www.healthquality.va.gov/mtbi/concussion_mtbi_full_1_0.pdf)



# Defining Complicated Mild TBI

- Three large studies,<sup>1-3</sup> representing data from ~ 4,000 individuals with mild TBI, demonstrate differences in the frequency of early (i.e., acute) CT abnormalities based on initial GCS score
  - GCS 15: 5-10%
  - GCS 13 or 14: 20-35%
- Outcomes of persons with GCS-defined mild TBI and early CT abnormalities (i.e., intracranial contusion or hemorrhage, depressed skull fracture) are similar to those of persons with GCS-defined moderate TBI<sup>4-6</sup>
- Accordingly, persons with early neuroimaging abnormalities in the context of phenomenologically mild TBI are classified as having “complicated mild TBI”<sup>4</sup>

1. Borczuk 1995; 2. Miller et al. 1997; 3. Haydel et al. 2000; 4. Williams et al. 1990; 5. van der Naalt et al. 1999; 6. Kashluba et al. 2008



# TBI Severity Classification

**Modified VA/DoD TBI Severity Classification System**

	<b>LOC</b> <b>(hours)</b>	<b>PTA</b> <b>(days)</b>	<b>AOC</b> <b>(days)</b>	<b>GCS</b> <b>score</b>	<b>CT or MRI</b>
<b>Mild TBI</b>	$\leq 0.5$	$\leq 1$	$\leq 1$	13-15	Normal
<b>Complicated Mild TBI</b>	$\leq 0.5$	$\leq 1$	$\leq 1$	13-15	Abnormal
<b>Moderate TBI</b>	$> 0.5$ to $< 24$	$> 1$ to $< 7$	$> 1$	9-12	Normal or abnormal
<b>Severe TBI</b>	$\geq 24$	$\geq 7$	$> 1$	3-8	Normal or abnormal

From Arciniegas DB. Addressing neuropsychiatric disturbances during rehabilitation after traumatic brain injury: current and future methods. Dialogues in Clinical Neuroscience 13(3):325-345, 2011.

Adapted from Defense and Veterans Brain Injury Center Working Group on the Acute Management of Traumatic Brain Injury in Military Operational Settings 2006; Clinical Practice Guideline: Management of Concussion/mild Traumatic Brain Injury, VHA 2009.





# Differential Diagnosis

## Box 2-1. COMMON ELEMENTS OF THE DIFFERENTIAL DIAGNOSIS OF INJURY EVENT-RELATED DISTURBANCES OF CONSCIOUSNESS

Traumatic brain injury

Preinjury medical or neurological condition altering consciousness (e.g., delirium)

Preinjury intoxication or withdrawal from alcohol or other substances

Peri-injury dehydration and/or hypovolemia

Peri-injury hypotension

Peri-injury hyperthermia or hypothermia

Peri-injury toxin inhalation

Cerebrovascular events (e.g., transient ischemic attack, stroke)

Cardiovascular compromise (e.g., cardiac arrest)

Cerebral hypoxia or hypoxia-ischemia

Seizure/postictal confusion due to preexisting epilepsy

Neurotrauma-induced seizures/postictal confusion

Medication-induced (iatrogenic) confusional state

Acute stress responses (e.g., severe anxiety reaction, acute stress-induced dissociative state)

## Box 2-2. COMMON ELEMENTS OF THE DIFFERENTIAL DIAGNOSIS OF EVENT-RELATED SENSORIMOTOR ABNORMALITIES

Preinjury sensorimotor disorders (e.g., headaches, tinnitus, vertigo)

Focal cerebral, cerebellar, and/or brain stem injuries

Cerebrovascular events (e.g., stroke, transient ischemic attack, vasoconstriction)

Cerebral hypoxia or hypoxia-ischemia

Subdural or epidural hematomas without overt brain injury

Simple partial (focal motor or sensory) seizure or postictal paralysis

Sensory organ injury (e.g., eye, middle or inner ear, nasal or oropharyngeal tissues)

Cranial nerve injury

Head and neck injuries

Spinal cord injury

Brachial or sacral plexus injury

Peripheral nerve injury

Limb or other bodily injury

# Major or Mild Neurocognitive Disorder Due to Traumatic Brain Injury

## Diagnostic Criteria

- A. The criteria are met for major or mild neurocognitive disorder.
- B. There is evidence of a traumatic brain injury—that is, an impact to the head or other mechanisms of rapid movement or displacement of the brain within the skull, with one or more of the following:
  - 1. Loss of consciousness.
  - 2. Posttraumatic amnesia.
  - 3. Disorientation and confusion.
  - 4. Neurological signs (e.g., neuroimaging demonstrating injury; a new onset of seizures; a marked worsening of a preexisting seizure disorder; visual field cuts; anisotropia; hemiparesis).
- C. The neurocognitive disorder presents immediately after the occurrence of the traumatic brain injury or immediately after recovery of consciousness and persists past the acute post-injury period.

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For mild neurocognitive disorder due to traumatic brain injury, code **331.83 (G31.84)**. (**Note:** Do *not* use the additional code for traumatic brain injury. Behavioral disturbance cannot be coded but should still be indicated in writing.)

American Psychiatric Association DSM-5 Task Force. Diagnostic and Statistical Manual of Mental Disorders: DSM-5. Washington, D.C.: American Psychiatric Association, 2013, pg. 624.





# Features of Neurocognitive Disorder due to TBI

- Cognitive impairments among persons with NDC due to TBI are most common in the domains of processing speed, complex attention, declarative memory, executive function, and social cognition
- Among persons with more severe TBI, particularly when associated with brain contusion, intracranial hemorrhage, or penetrating injury, additional deficits (e.g., aphasia, neglect, and constructional dyspraxia) may also be present

# Long-Term Cognitive Outcome after TBI

TBI Type	IOM Conclusions	Cognitive Domains Affected
Penetrating	Sufficient evidence	Vary with the affected brain region and volume of tissue lost
Severe	Sufficient evidence	<p>Common</p> <ul style="list-style-type: none"> <li>Attention</li> <li>Processing speed</li> <li>Episodic memory</li> <li>Executive function</li> </ul> <p>Less Common</p> <ul style="list-style-type: none"> <li>Language</li> <li>Praxis</li> <li>Visuospatial function</li> </ul>
Moderate	Limited/suggestive evidence	<ul style="list-style-type: none"> <li>Processing speed</li> <li>Episodic memory</li> <li>Executive function</li> </ul>

Adapted from Arciniegas DB: Posttraumatic cognitive impairments. In Arciniegas DB, Zasler ND, Vanderploeg RD, Jaffee MS: Management of Adults with Traumatic Brain Injury. American Psychiatric Publishing, Inc. Washington DC, 2013, pp. 131-164.

Data source for table construction: Dikmen SS et al.: Cognitive outcome following traumatic brain injury. J Head Trauma Rehabil. 2009 Nov-Dec;24(6):430-8.



# **NCD-Associated Behavioral Disturbances**

- Criteria for both Mild and Major NCD instruct specification of NCD-associated behavioral disturbances
  - delusions
  - hallucinations
  - mood disturbance
  - affective lability
  - agitation
  - disinhibition
  - wandering
  - apathy

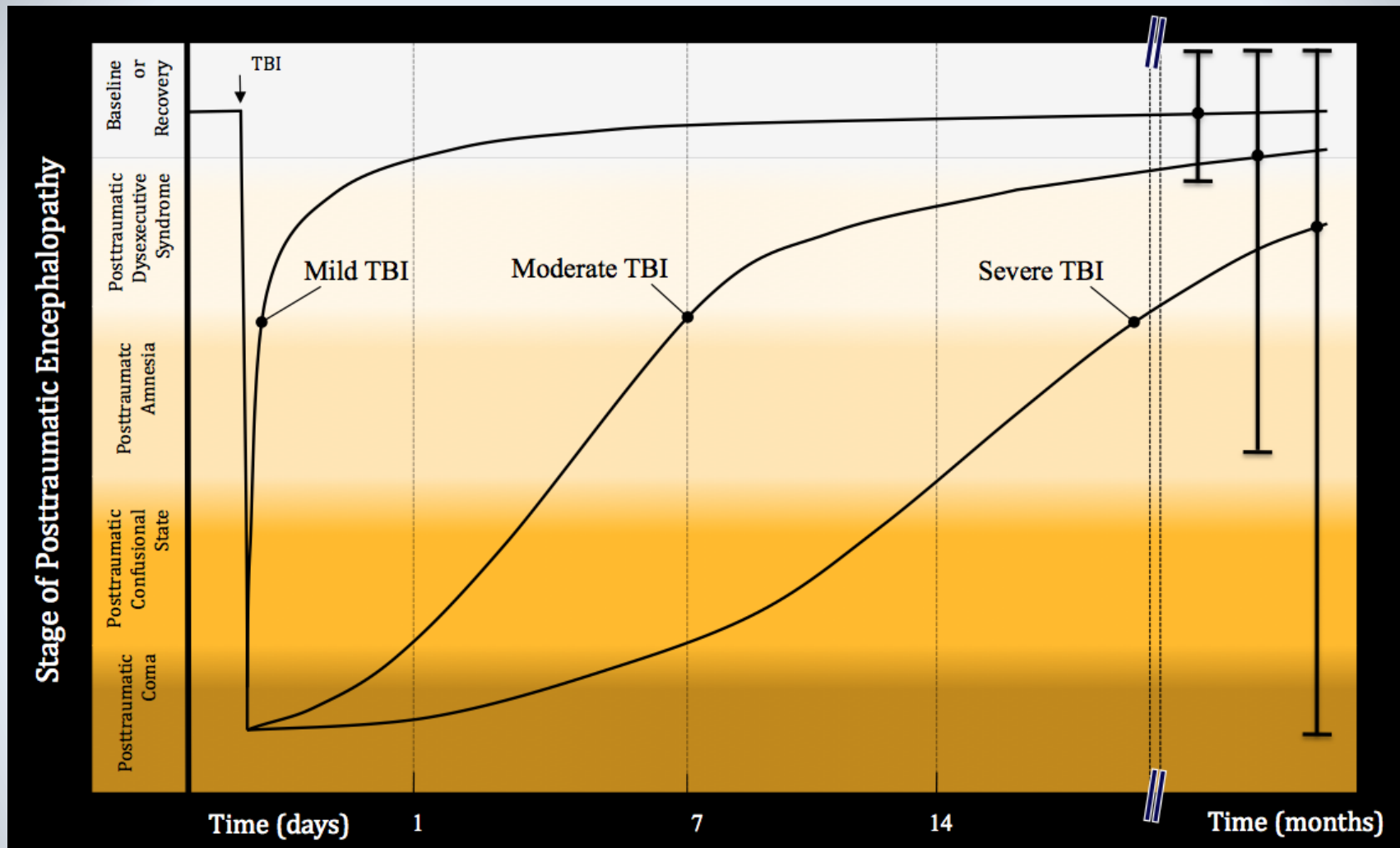
# **NCD-Associated Behavioral Disturbances**

- Among persons with mild TBI, other symptoms may potentially co-occur with neurocognitive symptoms (e.g., depression, irritability, fatigue, headache, photosensitivity, sleep disturbance)
- Like neurocognitive symptoms, these also tend to resolve in the weeks following mild TBI
- Substantial subsequent deterioration in these areas should trigger consideration of additional diagnoses.

# **NCD-Associated Behavioral Disturbances**

- Moderate and severe TBI may be associated with neurophysiological, emotional, and behavioral complications
  - seizures
  - photosensitivity
  - hyperacusis
  - irritability
  - depression
  - inability to resume occupational and social functioning at pre-injury level
  - deterioration in interpersonal relationships
  - possibly neurodegenerative diseases
  - aggression
  - sleep disturbance
  - fatigue
  - apathy

# Typical Courses after TBI



Arciniegas DB, McAllister TW. Cognitive Impairments. In Arciniegas DB, Zasler ND, Vanderploeg RD, Jaffee MS (editors): Clinical Manual for the Management of Adults with Traumatic Brain Injury. Washington DC, American Psychiatric Publishing, Inc., 2013, pp.131-164.

# Posttraumatic Symptoms: Development and Course

- Posttraumatic symptoms tend to be most severe immediately following TBI (any severity)
- Posttraumatic symptoms associated with mild TBI typically resolve within days to weeks, with complete resolution typical between 3 and 12 months
  - persistent symptoms are more likely in those with more acute symptoms and more emotional stress
  - deviation from typical course or late deterioration should trigger evaluation for other conditions
- Typical course after moderate or severe involves substantial, albeit sometimes incomplete, recovery

Carroll LJ, Cassidy JD, Cancelliere C, Cote P, Hincapie CA, Kristman VL, et al. Systematic review of the prognosis after mild traumatic brain injury in adults: cognitive, psychiatric, and mortality outcomes: results of the International Collaboration on Mild Traumatic Brain Injury Prognosis. Arch Phys Med Rehabil. 2014;95(3 Suppl):S152-73; Cassidy JD, Cancelliere C, Carroll LJ, Cote P, Hincapie CA, Holm LW, et al. Systematic review of self-reported prognosis in adults after mild traumatic brain injury: results of the International Collaboration on Mild Traumatic Brain Injury Prognosis. Arch Phys Med Rehabil. 2014;95(3 Suppl):S132-51.; Boyle E, Cancelliere C, Hartvigsen J, Carroll LJ, Holm LW, Cassidy JD. Systematic review of prognosis after mild traumatic brain injury in the military: results of the International Collaboration on Mild Traumatic Brain Injury Prognosis. Arch Phys Med Rehabil. 2014;95(3 Suppl):S230-7.





# Posttraumatic Symptoms: Development and Course

- Course and outcomes vary with many factors, including TBI severity, complications, age, pre- and post-injury neurological, psychiatric, substance abuse, and post-injury psychosocial factors
- Repeated mild TBI may be (but is not necessarily) associated with persisting neurocognitive disturbance
- Consequently, initial TBI severity does not bear a strict relationship to neurocognitive disorder severity
  - most persons with mild TBI recover fully and do not develop either Mild or Major NCD
  - outcome after moderate or severe TBI is variable, ranging from full recovery to Severe Major NCD



## **Section of Psychiatry**

President—T. A. Ross, M.D.

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[April 13, 1937]

### **Mental Disorder Following Head Injury**

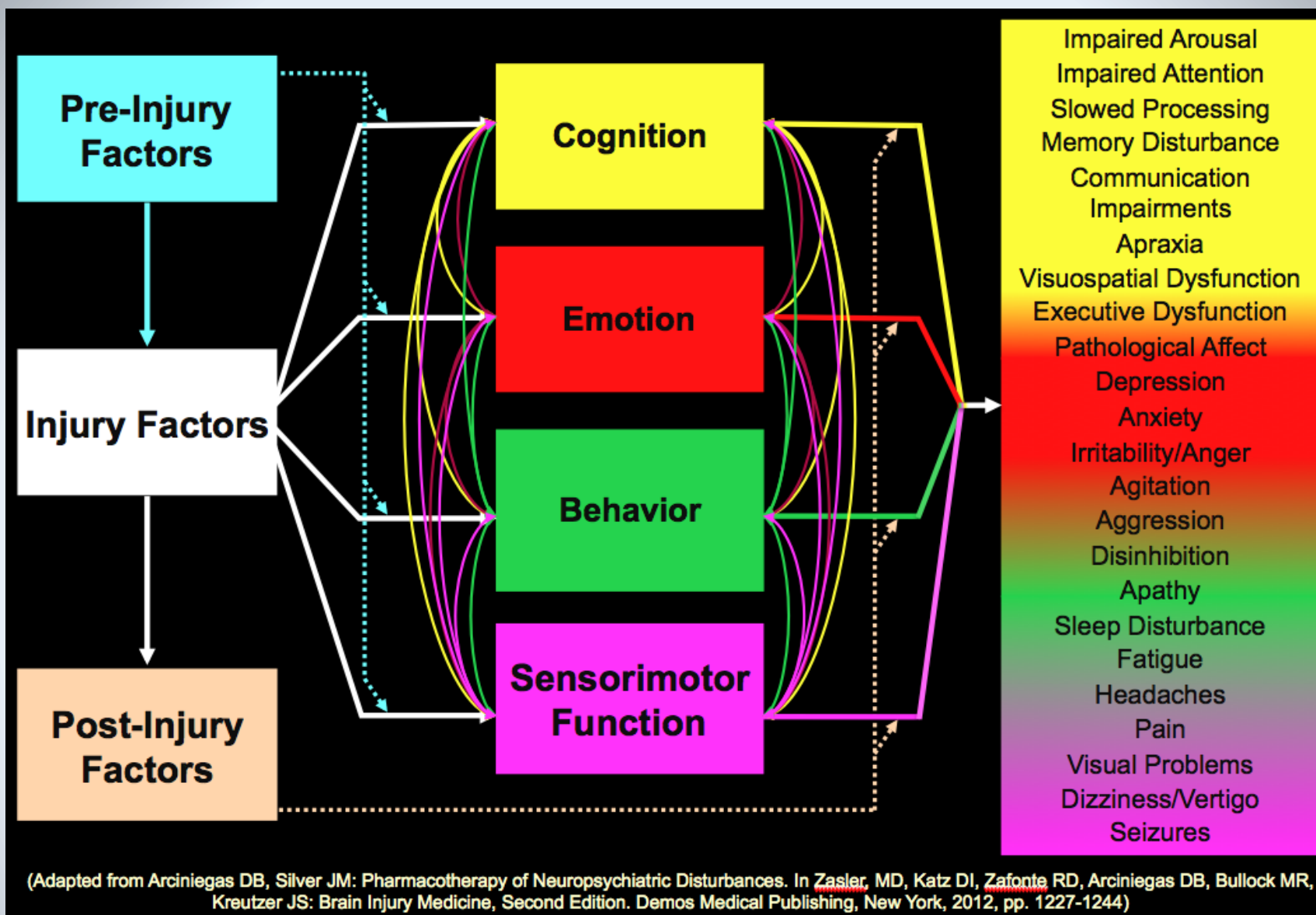
By C. P. SYMONDS, M.D.

THE outstanding feature of mental disorder after head injury is loss of consciousness in some degree. I add the qualification because a good deal of confusion is apt to arise in practice about what loss of consciousness means. It is argued quite reasonably that a man who is capable of answering questions, for instance, giving his name and address after an accident, is conscious. But if next day he has no recollection of having done so, or of the period of time when the incident occurred, he may with equal reason be said to have been unconscious of what he was doing. For purposes of description in head injuries, if a man has no memory of what he has done, we assume that he was not at that time fully conscious. Therefore, the duration of unconsciousness may be measured by that of the traumatic amnesia following the accident. It is the symptoms which may be observed during this period of traumatic amnesia that I shall first discuss.

In order to understand the effects of head injury, we must undertake full study of the individual's constitution. In other words, it is not just the kind of injury that matters, but the kind of head that is injured.

*Sir Charles Symonds, 1937*





A heuristic for understanding symptom development and persistence after TBI: interaction between pre-injury, injury-related, and post-injury factors.

# Progress

- When compared prior edition of this manual, the DSM-5 approach to TBI is improved by:
  - a clear definition of TBI that comports with those used currently in other clinical and research contexts
  - incorporation of criteria for rating the severity of a TBI that are similar to those used in other clinical and research contexts and highlighting the prognostic importance of such ratings
  - describing the expected course of recovery after mild TBI as well as moderate-to-severe TBI
  - encouraging clinicians to entertain alternative explanations for cognitive and other neuropsychiatric symptoms when recovery and/or outcome severity is atypical



## **Other Psychiatric Disorders due to TBI in DSM-5**

- Permits diagnosis of wide variety of psychiatric disorders due to another medical condition, including: depressive disorder; bipolar and related disorder; anxiety disorder; psychotic disorder; personality changes (e.g., labile, disinhibited, aggressive, apathetic, paranoid)
- DSM-5 leaves somewhat unclear when NCD-associated behavioral disturbance as opposed to psychiatric disorder due to another medical condition is most appropriate diagnosis



## **Other Psychiatric Disorders due to TBI in DSM-5**

- When specific symptoms fall short of criteria for another psychiatric disorder, symptoms may be subsumed under the NCD diagnosis
- When specific psychiatric symptoms (e.g., prominent and persistent depression) begins to predominate clinical picture with course independent of NCD, and clear relationship between symptoms and pathophysiological consequences of TBI, diagnosis of symptom-specific disorder due to TBI is reasonable

# **Clinical Implications of the DSM-5 Approach to TBI**

- A successful effort to harmonize DSM-5 TBI definition, severity characterization, course, and outcome expectations with neurotrauma and rehabilitation research communities and within the constraints of the NCD framework
- Mental health professionals, by virtue of exposure to DSM-5, will be more able to accurately characterize injury events as TBI, with definitions consistent with national and international standards

# **Clinical Implications of the DSM-5 Approach to TBI**

- Offers guidance to distinguish between TBI of mild and more-than-mild severity and to understand the natural histories typical of these injury severities
- Highlights importance of entertaining a broad differential diagnosis for persistent cognitive, emotional, behavioral, and other physical symptoms, especially when the severity of symptoms appears inconsistent with the severity of TBI
- Encourages providers to identify and treat both the neuropsychiatric complications and neuropsychiatric comorbidities that occur commonly among persons with TBI

